student-performance-project

November 17, 2024

[ ]:
```
# Name = Ashutosh Sharma
# RegID = 12409632
# Section = RD2445A05
```

[1]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.model_selection import train_test_split
from sklearn.linear_model import LogisticRegression
from sklearn.ensemble import RandomForestClassifier
from sklearn.metrics import classification_report, accuracy_score,␣
↪confusion_matrix
from sklearn.preprocessing import StandardScaler
```

[2]:
```
data=pd.read_csv("StudentPerformanceFactor.csv")
data
```

[2]:

	Hours_Studied	Attendance	Parental_Involvement	Access_to_Resources	\
0	23	84	Low	High	
1	19	64	Low	Medium	
2	24	98	Medium	Medium	
3	29	89	Low	Medium	
4	19	92	Medium	Medium	
..	…	…	…	…	
194	21	79	Medium	High	
195	22	79	High	Medium	
196	15	95	Low	Low	
197	21	91	Medium	High	
198	20	81	High	Medium	

	Extracurricular_Activities	Sleep_Hours	Previous_Scores	Motivation_Level	\
0	No	7	73	Low	
1	No	8	59	Low	
2	Yes	7	91	Medium	
3	Yes	8	98	Medium	
4	Yes	6	65	Medium	

```
..                          …          …              …               …
194                       Yes          7             66             Low
195                        No          5            100          Medium
196                       Yes          6             88             Low
197                       Yes          5             84          Medium
198                       Yes          6             51            High
```

```
    Internet_Access  Tutoring_Sessions Family_Income Teacher_Quality  \
0               Yes                  0           Low          Medium
1               Yes                  2        Medium          Medium
2               Yes                  2        Medium          Medium
3               Yes                  1        Medium          Medium
4               Yes                  3        Medium            High
..              …                  …            …               …
194             Yes                  2           Low          Medium
195             Yes                  4          High            High
196             Yes                  1           Low          Medium
197             Yes                  1          High             Low
198              No                  3        Medium          Medium
```

```
    School_Type Peer_Influence  Physical_Activity Learning_Disabilities  \
0        Public       Positive                  3                    No
1        Public       Negative                  4                    No
2        Public        Neutral                  4                    No
3        Public       Negative                  4                    No
4        Public        Neutral                  4                    No
..          …            …                  …                   …
194      Public       Negative                  4                    No
195      Public       Negative                  3                    No
196      Public       Negative                  5                    No
197      Public        Neutral                  2                    No
198      Public        Neutral                  4                   Yes
```

```
    Parental_Education_Level Distance_from_Home  Gender  Exam_Score
0                High School               Near    Male          67
1                    College           Moderate  Female          61
2               Postgraduate               Near    Male          74
3                High School           Moderate    Male          71
4                    College               Near  Female          70
..                       …                  …     …         …
194                  College           Moderate    Male          67
195                  College               Near    Male          72
196              High School               Near    Male          66
197              High School               Near    Male          70
198              High School               Near    Male          67
```

```
[199 rows x 20 columns]
```

[3]:
```
data.head()
```

[3]:

	Hours_Studied	Attendance	Parental_Involvement	Access_to_Resources	Extracurricular_Activities	Sleep_Hours	Previous_Scores	Motivation_Level	Internet_Access	Tutoring_Sessions	Family_Income	Teacher_Quality	School_Type	Peer_Influence	Physical_Activity	Learning_Disabilities	Parental_Education_Level	Distance_from_Home	Gender	Exam_Score
0	23	84	Low	High	No	7	73	Low	Yes	0	Low	Medium	Public	Positive	3	No	High School	Near	Male	67
1	19	64	Low	Medium	No	8	59	Low	Yes	2	Medium	Medium	Public	Negative	4	No	College	Moderate	Female	61
2	24	98	Medium	Medium	Yes	7	91	Medium	Yes	2	Medium	Medium	Public	Neutral	4	No	Postgraduate	Near	Male	74
3	29	89	Low	Medium	Yes	8	98	Medium	Yes	1	Medium	Medium	Public	Negative	4	No	High School	Moderate	Male	71
4	19	92	Medium	Medium	Yes	6	65	Medium	Yes	3	Medium	High	Public	Neutral	4	No	College	Near	Female	70

[4]:
```
data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 199 entries, 0 to 198
Data columns (total 20 columns):
 #   Column                      Non-Null Count  Dtype
---  ------                      --------------  -----
 0   Hours_Studied               199 non-null    int64
 1   Attendance                  199 non-null    int64
 2   Parental_Involvement        199 non-null    object
```

```
 3   Access_to_Resources          199 non-null    object
 4   Extracurricular_Activities   199 non-null    object
 5   Sleep_Hours                  199 non-null    int64
 6   Previous_Scores              199 non-null    int64
 7   Motivation_Level             199 non-null    object
 8   Internet_Access              199 non-null    object
 9   Tutoring_Sessions            199 non-null    int64
 10  Family_Income                199 non-null    object
 11  Teacher_Quality              198 non-null    object
 12  School_Type                  199 non-null    object
 13  Peer_Influence               199 non-null    object
 14  Physical_Activity            199 non-null    int64
 15  Learning_Disabilities        199 non-null    object
 16  Parental_Education_Level     199 non-null    object
 17  Distance_from_Home           198 non-null    object
 18  Gender                       199 non-null    object
 19  Exam_Score                   199 non-null    int64
dtypes: int64(7), object(13)
memory usage: 31.2+ KB
```

[5]:
```
data.describe()
```

[5]:

	Hours_Studied	Attendance	Sleep_Hours	Previous_Scores	\
count	199.000000	199.000000	199.000000	199.000000	
mean	19.819095	80.170854	6.859296	76.467337	
std	5.556636	11.619861	1.403567	14.733583	
min	4.000000	60.000000	4.000000	50.000000	
25%	16.000000	70.000000	6.000000	65.000000	
50%	20.000000	79.000000	7.000000	78.000000	
75%	23.000000	91.000000	8.000000	89.000000	
max	36.000000	100.000000	10.000000	100.000000	

	Tutoring_Sessions	Physical_Activity	Exam_Score
count	199.000000	199.000000	199.000000
mean	1.497487	3.040201	67.336683
std	1.154151	1.038838	3.918644
min	0.000000	0.000000	60.000000
25%	1.000000	2.000000	65.000000
50%	1.000000	3.000000	67.000000
75%	2.000000	4.000000	69.000000
max	5.000000	6.000000	100.000000

[6]:
```
data.duplicated().sum()
```

[6]: 0

[7]:
```
data.isnull().sum()
```

[7]:
```
Hours_Studied                 0
Attendance                    0
Parental_Involvement          0
Access_to_Resources           0
Extracurricular_Activities    0
Sleep_Hours                   0
Previous_Scores               0
Motivation_Level              0
Internet_Access               0
Tutoring_Sessions             0
Family_Income                 0
Teacher_Quality               1
School_Type                   0
Peer_Influence                0
Physical_Activity             0
Learning_Disabilities         0
Parental_Education_Level      0
Distance_from_Home            1
Gender                        0
Exam_Score                    0
dtype: int64
```

[8]:
```
data['Teacher_Quality'].fillna(0,inplace = True)
data
```

```
C:\Users\ASHUTOSH SHARMA\AppData\Local\Temp\ipykernel_19020\1301136774.py:1:
FutureWarning: A value is trying to be set on a copy of a DataFrame or Series
through chained assignment using an inplace method.
The behavior will change in pandas 3.0. This inplace method will never work
because the intermediate object on which we are setting values always behaves as
a copy.

For example, when doing 'df[col].method(value, inplace=True)', try using
'df.method({col: value}, inplace=True)' or df[col] = df[col].method(value)
instead, to perform the operation inplace on the original object.
```

```
  data['Teacher_Quality'].fillna(0,inplace = True)
```

[8]:

	Hours_Studied	Attendance	Parental_Involvement	Access_to_Resources	\
0	23	84	Low	High	
1	19	64	Low	Medium	
2	24	98	Medium	Medium	
3	29	89	Low	Medium	
4	19	92	Medium	Medium	
..	…	…	…	…	
194	21	79	Medium	High	

```
195             22          79                 High             Medium
196             15          95                  Low                Low
197             21          91               Medium               High
198             20          81                 High             Medium

    Extracurricular_Activities  Sleep_Hours  Previous_Scores Motivation_Level  \
0                           No            7               73              Low
1                           No            8               59              Low
2                          Yes            7               91           Medium
3                          Yes            8               98           Medium
4                          Yes            6               65           Medium
..                         …          …              …              …
194                        Yes            7               66              Low
195                         No            5              100           Medium
196                        Yes            6               88              Low
197                        Yes            5               84           Medium
198                        Yes            6               51             High

    Internet_Access  Tutoring_Sessions Family_Income Teacher_Quality  \
0               Yes                  0           Low          Medium
1               Yes                  2        Medium          Medium
2               Yes                  2        Medium          Medium
3               Yes                  1        Medium          Medium
4               Yes                  3        Medium            High
..              …                …           …              …
194             Yes                  2           Low          Medium
195             Yes                  4          High            High
196             Yes                  1           Low          Medium
197             Yes                  1          High             Low
198              No                  3        Medium          Medium

    School_Type Peer_Influence  Physical_Activity Learning_Disabilities  \
0        Public       Positive                  3                    No
1        Public       Negative                  4                    No
2        Public        Neutral                  4                    No
3        Public       Negative                  4                    No
4        Public        Neutral                  4                    No
..          …            …                …                    …
194      Public       Negative                  4                    No
195      Public       Negative                  3                    No
196      Public       Negative                  5                    No
197      Public        Neutral                  2                    No
198      Public        Neutral                  4                   Yes

    Parental_Education_Level Distance_from_Home  Gender  Exam_Score
0                High School               Near    Male          67
1                    College           Moderate  Female          61
```

```
2              Postgraduate              Near    Male          74
3               High School          Moderate    Male          71
4                   College              Near  Female          70
..                      …                 …     …          …
194                 College          Moderate    Male          67
195                 College              Near    Male          72
196              High School             Near    Male          66
197              High School             Near    Male          70
198              High School             Near    Male          67

[199 rows x 20 columns]
```

[9]:
```
data['Distance_from_Home'].fillna(0,inplace = True)
data
```

```
C:\Users\ASHUTOSH SHARMA\AppData\Local\Temp\ipykernel_19020\715270329.py:1:
FutureWarning: A value is trying to be set on a copy of a DataFrame or Series
through chained assignment using an inplace method.
The behavior will change in pandas 3.0. This inplace method will never work
because the intermediate object on which we are setting values always behaves as
a copy.

For example, when doing 'df[col].method(value, inplace=True)', try using
'df.method({col: value}, inplace=True)' or df[col] = df[col].method(value)
instead, to perform the operation inplace on the original object.
```

```
  data['Distance_from_Home'].fillna(0,inplace = True)
```

[9]:
```
     Hours_Studied  Attendance Parental_Involvement Access_to_Resources  \
0               23          84                  Low                High
1               19          64                  Low              Medium
2               24          98               Medium              Medium
3               29          89                  Low              Medium
4               19          92               Medium              Medium
..             …           …                    …                   …
194             21          79               Medium                High
195             22          79                 High              Medium
196             15          95                  Low                 Low
197             21          91               Medium                High
198             20          81                 High              Medium

    Extracurricular_Activities  Sleep_Hours  Previous_Scores Motivation_Level  \
0                           No            7               73              Low
1                           No            8               59              Low
2                          Yes            7               91           Medium
3                          Yes            8               98           Medium
```

```
4                         Yes            6               65           Medium
..                        …          …               …              …
194                       Yes            7               66              Low
195                        No            5              100           Medium
196                       Yes            6               88              Low
197                       Yes            5               84           Medium
198                       Yes            6               51             High

    Internet_Access  Tutoring_Sessions Family_Income Teacher_Quality  \
0               Yes                  0           Low          Medium
1               Yes                  2        Medium          Medium
2               Yes                  2        Medium          Medium
3               Yes                  1        Medium          Medium
4               Yes                  3        Medium            High
..              …                  …           …              …
194             Yes                  2           Low          Medium
195             Yes                  4          High            High
196             Yes                  1           Low          Medium
197             Yes                  1          High             Low
198              No                  3        Medium          Medium

    School_Type Peer_Influence  Physical_Activity Learning_Disabilities  \
0        Public       Positive                  3                    No
1        Public       Negative                  4                    No
2        Public        Neutral                  4                    No
3        Public       Negative                  4                    No
4        Public        Neutral                  4                    No
..          …            …                 …                   …
194      Public       Negative                  4                    No
195      Public       Negative                  3                    No
196      Public       Negative                  5                    No
197      Public        Neutral                  2                    No
198      Public        Neutral                  4                   Yes

    Parental_Education_Level Distance_from_Home  Gender  Exam_Score
0                High School               Near    Male          67
1                    College           Moderate  Female          61
2               Postgraduate               Near    Male          74
3                High School           Moderate    Male          71
4                    College               Near  Female          70
..                       …                …     …         …
194                  College           Moderate    Male          67
195                  College               Near    Male          72
196              High School               Near    Male          66
197              High School               Near    Male          70
198              High School               Near    Male          67
```

```
[199 rows x 20 columns]
```

[10]:
```
data.isnull().sum()
```

[10]:
```
Hours_Studied                 0
Attendance                    0
Parental_Involvement          0
Access_to_Resources           0
Extracurricular_Activities    0
Sleep_Hours                   0
Previous_Scores               0
Motivation_Level              0
Internet_Access               0
Tutoring_Sessions             0
Family_Income                 0
Teacher_Quality               0
School_Type                   0
Peer_Influence                0
Physical_Activity             0
Learning_Disabilities         0
Parental_Education_Level      0
Distance_from_Home            0
Gender                        0
Exam_Score                    0
dtype: int64
```

[11]:
```
for i in data.select_dtypes(include='number'):
    print(i, "=====", data[i].unique())
```

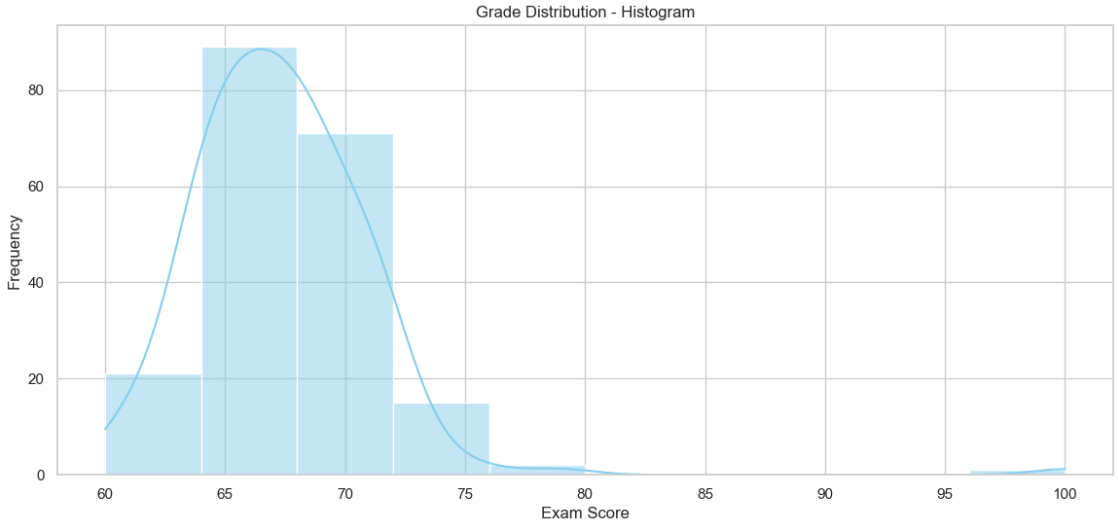
```
Hours_Studied ===== [23 19 24 29 25 17 21  9 10 14 22 15 12 20 11 13 16 18 31  8
26 28  4 35
 27 33 36]
Attendance ===== [ 84  64  98  89  92  88  78  94  80  97  83  82  68  60  70
75  99  74
  65  62  91  90  66  69  72  63  61  86  77  71  67  87  73  96 100  81
  95  79  85  76  93]
Sleep_Hours ===== [ 7  8  6 10  9  5  4]
Previous_Scores ===== [ 73  59  91  98  65  89  68  50  80  71  88  87  97  72
74  70  82  58
  99  84 100  75  54  90  94  51  57  66  96  93  56  52  63  79  81  69
  95  60  92  77  62  85  78  64  76  55  86  61  53]
Tutoring_Sessions ===== [0 2 1 3 4 5]
Physical_Activity ===== [3 4 2 1 5 0 6]
Exam_Score ===== [ 67  61  74  71  70  66  69  72  68  65  64  60  63  62 100
76  79  73]
```

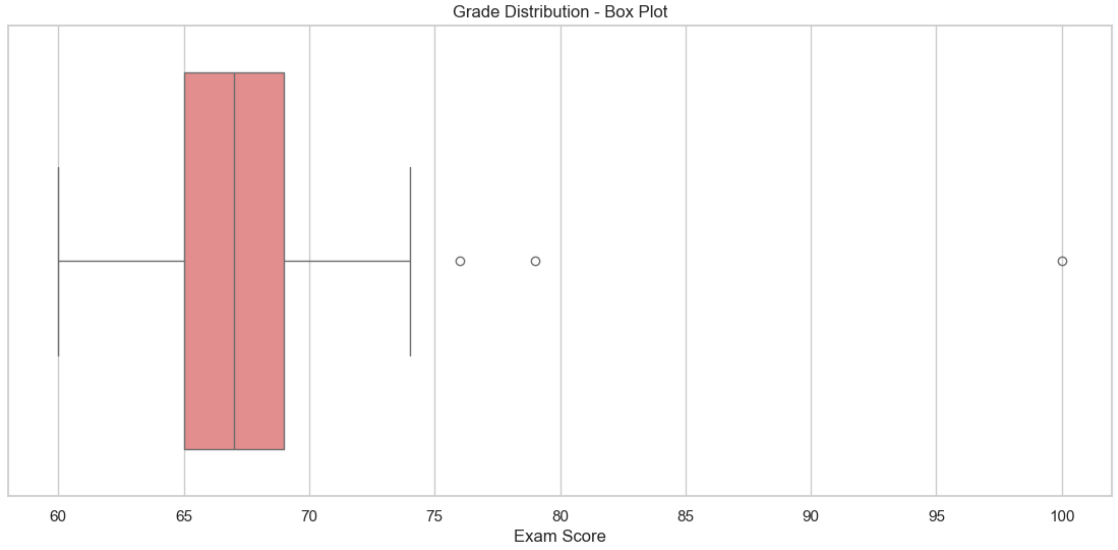
[12]:
```
num_col = data.select_dtypes(include ='number')
num_col.corr()
```

[12]:

	Hours_Studied	Attendance	Sleep_Hours	Previous_Scores	Tutoring_Sessions	Physical_Activity	Exam_Score
Hours_Studied	1.000000	-0.056307	-0.040839	-0.046032	-0.003221	-0.101101	0.343772
Attendance	-0.056307	1.000000	-0.062311	-0.032535	-0.026329	-0.043248	0.586590
Sleep_Hours	-0.040839	-0.062311	1.000000	-0.010725	-0.112458	0.031609	-0.140102
Previous_Scores	-0.046032	-0.032535	-0.010725	1.000000	-0.061856	-0.005193	0.131275
Tutoring_Sessions	-0.003221	-0.026329	-0.112458	-0.061856	1.000000	-0.029402	0.190585
Physical_Activity	-0.101101	-0.043248	0.031609	-0.005193	-0.029402	1.000000	-0.062893
Exam_Score	0.343772	0.586590	-0.140102	0.131275	0.190585	-0.062893	1.000000

[13]:
```
sns.set(style="whitegrid")

plt.figure(figsize=(14, 6))
sns.histplot(data['Exam_Score'], bins=10, kde=True, color="skyblue")
plt.title('Grade Distribution - Histogram')
plt.xlabel('Exam Score')
plt.ylabel('Frequency')
plt.show()


plt.figure(figsize=(14, 6))
sns.boxplot(x=data['Exam_Score'], color="lightcoral")
plt.title('Grade Distribution - Box Plot')
plt.xlabel('Exam Score')
plt.show()
```

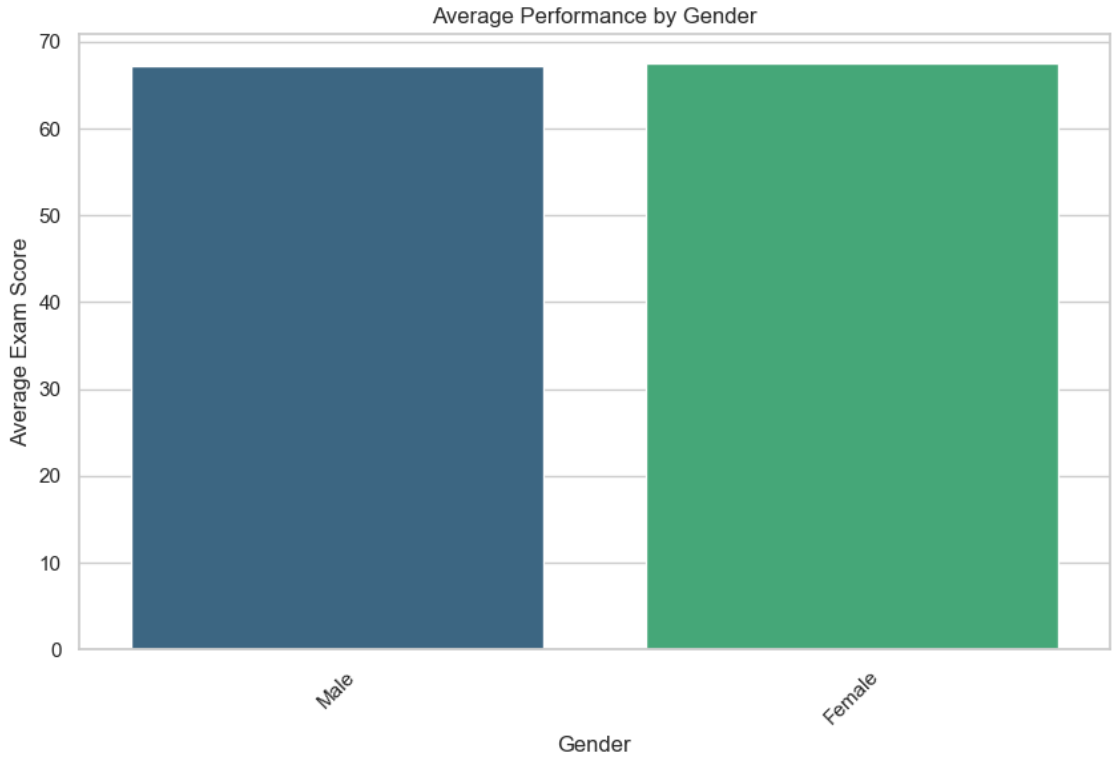




[29]:
```
plt.figure(figsize=(10, 6))
sns.barplot(x='Gender', y='Exam_Score', data=data, palette="viridis",␣
 ↪errorbar=None)
plt.title('Average Performance by Gender')
plt.xlabel('Gender')
plt.ylabel('Average Exam Score')
plt.xticks(rotation=45)
plt.show()
```

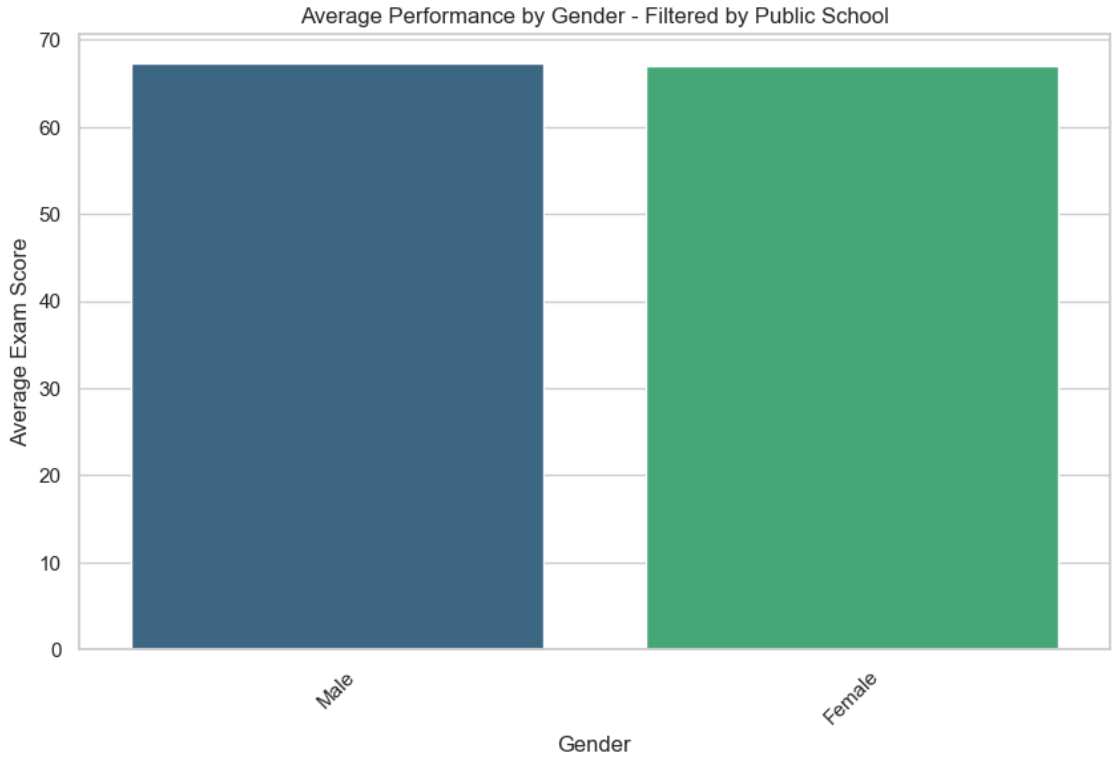
```
filtered_data = data[data['School_Type'] == 'Public']
plt.figure(figsize=(10, 6))
sns.barplot(x='Gender', y='Exam_Score', data=filtered_data, palette="viridis",␣
 ↪errorbar=None)
plt.title('Average Performance by Gender - Filtered by Public School')
plt.xlabel('Gender')
plt.ylabel('Average Exam Score')
plt.xticks(rotation=45)
plt.show()
```

```
C:\Users\ASHUTOSH SHARMA\AppData\Local\Temp\ipykernel_19020\300277467.py:2:
FutureWarning:

Passing `palette` without assigning `hue` is deprecated and will be removed in
v0.14.0. Assign the `x` variable to `hue` and set `legend=False` for the same
effect.

  sns.barplot(x='Gender', y='Exam_Score', data=data, palette="viridis",
errorbar=None)
```

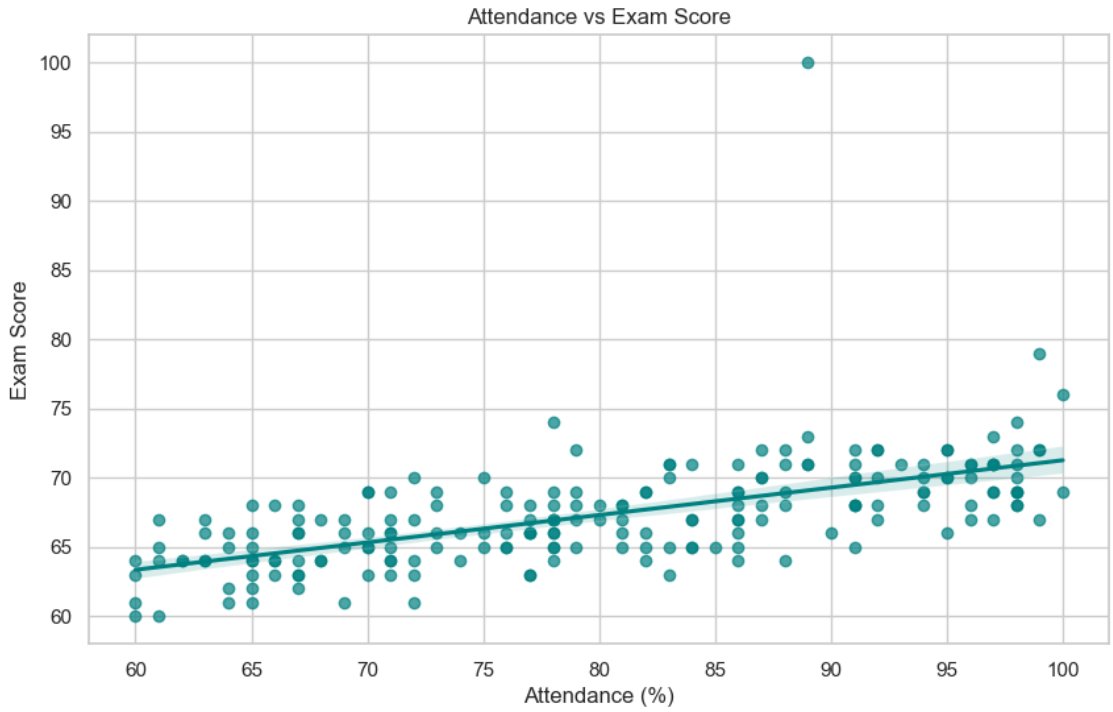



```
C:\Users\ASHUTOSH SHARMA\AppData\Local\Temp\ipykernel_19020\300277467.py:12:
FutureWarning:
```

```
Passing `palette` without assigning `hue` is deprecated and will be removed in
v0.14.0. Assign the `x` variable to `hue` and set `legend=False` for the same
effect.

  sns.barplot(x='Gender', y='Exam_Score', data=filtered_data, palette="viridis",
errorbar=None)
```



[15]:
```
plt.figure(figsize=(10, 6))
sns.regplot(x='Attendance', y='Exam_Score', data= data, color="teal",␣
 ↪scatter_kws={'alpha':0.7})
plt.title('Attendance vs Exam Score')
plt.xlabel('Attendance (%)')
plt.ylabel('Exam Score')
plt.show()
```



[28]:
```
data['Semester'] = np.random.randint(1, 6, data.shape[0])
plt.figure(figsize=(10, 6))
sns.lineplot(x='Semester', y='Exam_Score', data=data, marker="o", errorbar=None)
plt.title('Average Exam Score Trend Over Semesters')
plt.xlabel('Semester')
plt.ylabel('Average Exam Score')
plt.xticks(ticks=[1, 2, 3, 4, 5], labels=['Semester 1', 'Semester 2', 'Semester␣
↪3', 'Semester 4', 'Semester 5'])
plt.show()
```

[17]:
```
data['At_Risk'] = (data['Exam_Score'] < 60).astype(int)
```

[18]:
```
features = ['Attendance', 'Previous_Scores', 'Hours_Studied']
X = data[features]
y = data['At_Risk']
```

[19]:
```
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.3,␣
↪random_state=42)
```

[20]:
```
scaler = StandardScaler()
X_train_scaled = scaler.fit_transform(X_train)
X_test_scaled = scaler.transform(X_test)
```

[21]:
```
rf_model = RandomForestClassifier(random_state=42)
rf_model.fit(X_train, y_train)
```

[21]:
```
RandomForestClassifier(random_state=42)
```

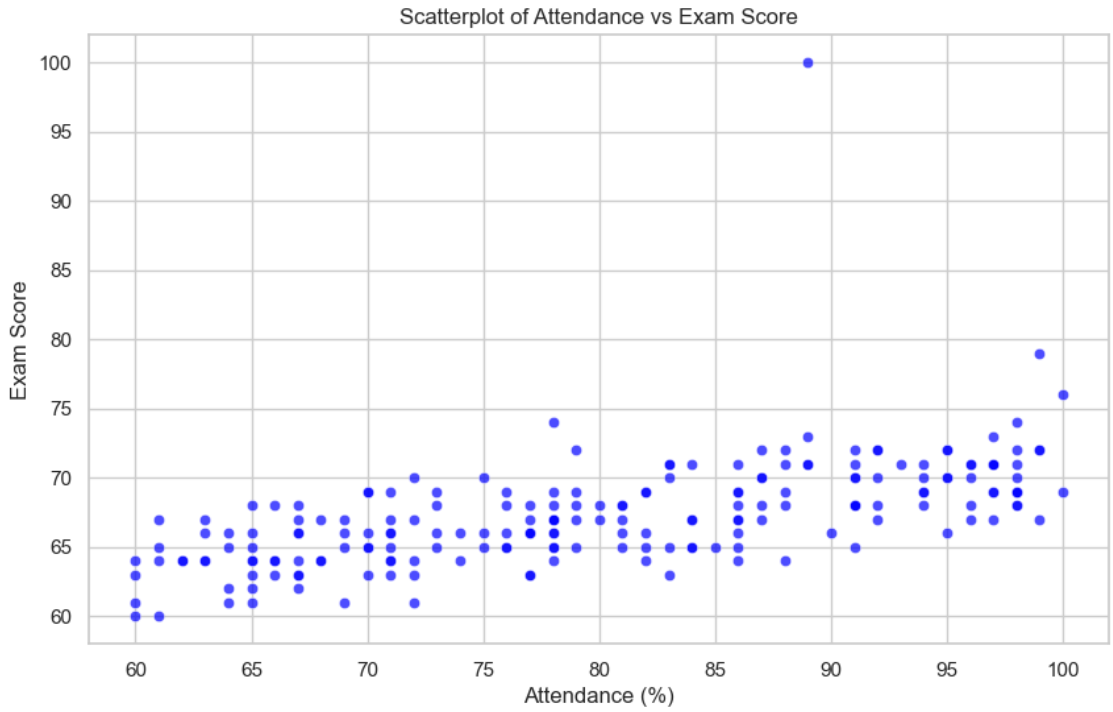
[22]:
```
y_pred_rf = rf_model.predict(X_test)
print("Random Forest - Classification Report:\n", classification_report(y_test,␣
↪y_pred_rf))
print("Random Forest - Accuracy Score:", accuracy_score(y_test, y_pred_rf))
print("Random Forest - Confusion Matrix:\n", confusion_matrix(y_test,␣
↪y_pred_rf))
```

```
Random Forest - Classification Report:
              precision    recall  f1-score   support

           0       1.00      1.00      1.00        60

    accuracy                           1.00        60
   macro avg       1.00      1.00      1.00        60
weighted avg       1.00      1.00      1.00        60

Random Forest - Accuracy Score: 1.0
Random Forest - Confusion Matrix:
 [[60]]
```

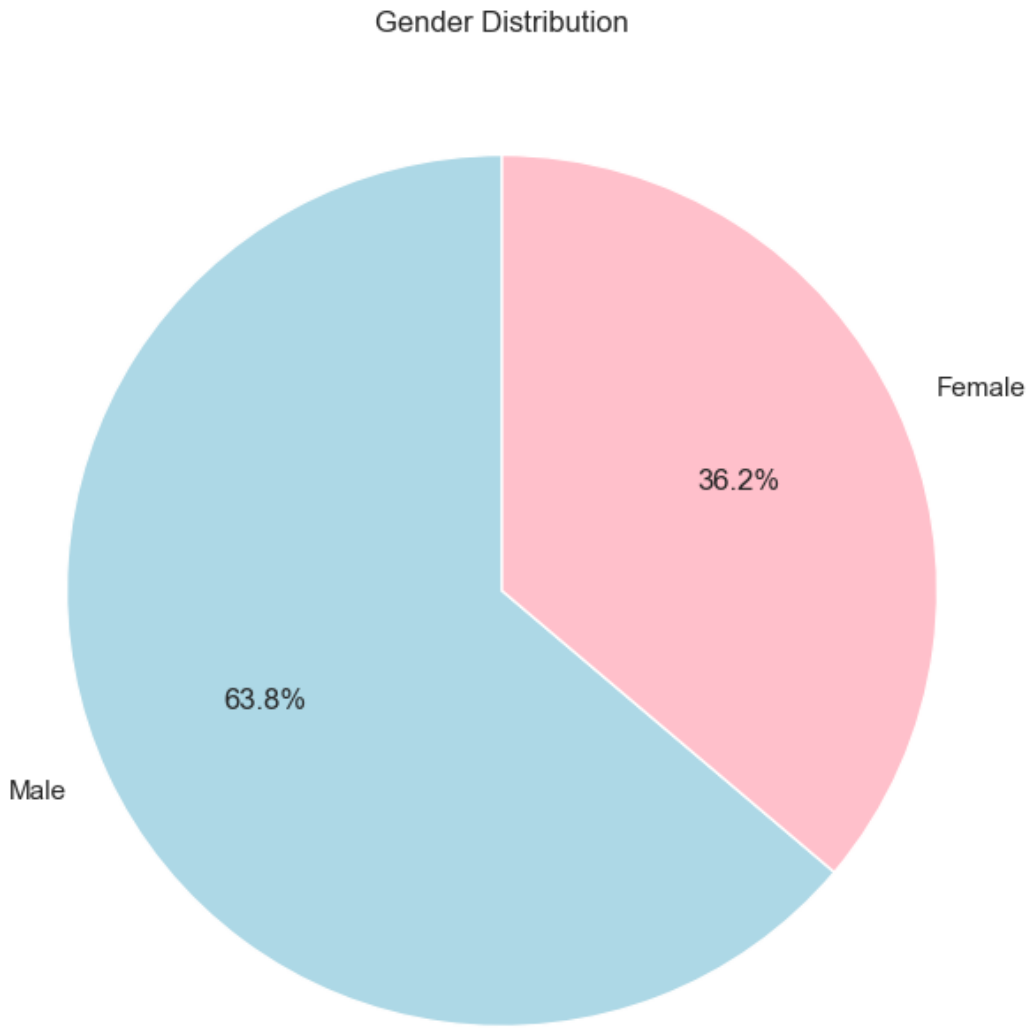
```
C:\Users\ASHUTOSH SHARMA\anaconda3\Lib\site-
packages\sklearn\metrics\_classification.py:386: UserWarning: A single label was
found in 'y_true' and 'y_pred'. For the confusion matrix to have the correct
shape, use the 'labels' parameter to pass all known labels.
  warnings.warn(
```

[23]:
```
correlation_matrix = data[['Attendance', 'Previous_Scores', 'Hours_Studied',␣
↪'Exam_Score']].corr()


plt.figure(figsize=(8, 6))
sns.heatmap(correlation_matrix, annot=True, cmap="coolwarm", fmt=".2f")
plt.title('Feature Correlation Heatmap')
plt.show()
```

[24]:
```
plt.figure(figsize=(10, 6))
sns.scatterplot(x='Attendance', y='Exam_Score', data=data, color="blue",␣
↪alpha=0.7)
plt.title('Scatterplot of Attendance vs Exam Score')
plt.xlabel('Attendance (%)')
plt.ylabel('Exam Score')
plt.show()
```



[25]:
```
gender_counts = data['Gender'].value_counts()

plt.figure(figsize=(8, 8))
plt.pie(gender_counts, labels=gender_counts.index, autopct='%1.1f%%',␣
 ↪startangle=90, colors=["lightblue", "pink"])
plt.title('Gender Distribution')
plt.show()
```



[26]:
```
sns.pairplot(data[['Attendance', 'Previous_Scores', 'Hours_Studied',␣
↪'Exam_Score']], diag_kind='kde', kind='scatter', palette="coolwarm")
plt.suptitle('Pairplot of Key Features', y=1.02)
plt.show()
```

```
C:\Users\ASHUTOSH SHARMA\anaconda3\Lib\site-packages\seaborn\axisgrid.py:1513:
UserWarning: Ignoring `palette` because no `hue` variable has been assigned.
  func(x=vector, **plot_kwargs)
C:\Users\ASHUTOSH SHARMA\anaconda3\Lib\site-packages\seaborn\axisgrid.py:1513:
UserWarning: Ignoring `palette` because no `hue` variable has been assigned.
  func(x=vector, **plot_kwargs)
C:\Users\ASHUTOSH SHARMA\anaconda3\Lib\site-packages\seaborn\axisgrid.py:1513:
```

```
UserWarning: Ignoring `palette` because no `hue` variable has been assigned.
  func(x=vector, **plot_kwargs)
C:\Users\ASHUTOSH SHARMA\anaconda3\Lib\site-packages\seaborn\axisgrid.py:1513:
UserWarning: Ignoring `palette` because no `hue` variable has been assigned.
  func(x=vector, **plot_kwargs)
C:\Users\ASHUTOSH SHARMA\anaconda3\Lib\site-packages\seaborn\axisgrid.py:1615:
UserWarning: Ignoring `palette` because no `hue` variable has been assigned.
  func(x=x, y=y, **kwargs)
C:\Users\ASHUTOSH SHARMA\anaconda3\Lib\site-packages\seaborn\axisgrid.py:1615:
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```
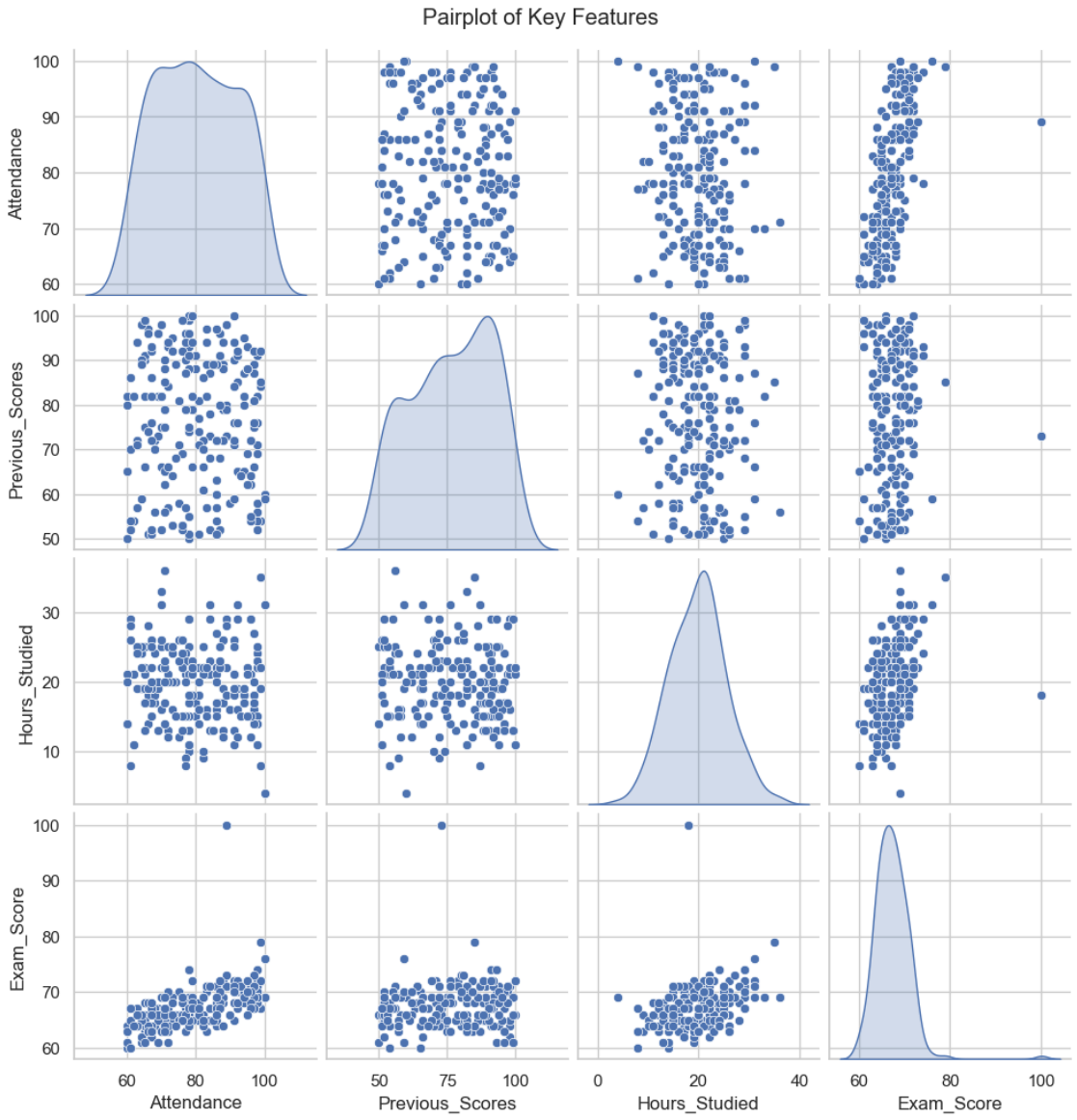
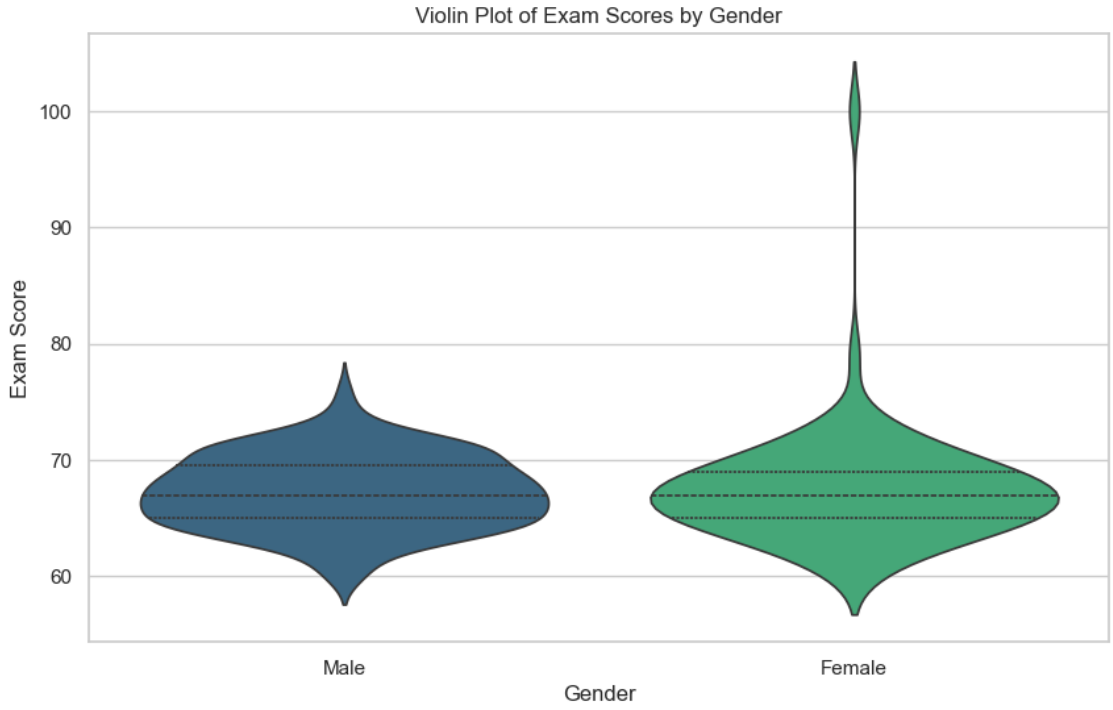



[27]:
```
plt.figure(figsize=(10, 6))
sns.violinplot(x='Gender', y='Exam_Score', data=data, palette="viridis",␣
↪inner="quartile")
plt.title('Violin Plot of Exam Scores by Gender')
plt.xlabel('Gender')
plt.ylabel('Exam Score')
plt.show()
```

```
C:\Users\ASHUTOSH SHARMA\AppData\Local\Temp\ipykernel_19020\346760998.py:2:
FutureWarning:

Passing `palette` without assigning `hue` is deprecated and will be removed in
```

```
v0.14.0. Assign the `x` variable to `hue` and set `legend=False` for the same
effect.

  sns.violinplot(x='Gender', y='Exam_Score', data=data, palette="viridis",
inner="quartile")
```




```
[ ]:
```